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AGRICULTURE IN BRAZIL´S MIDWEST REGION: LIMITATIONS AND FUTURE CHALLENGES TO DEVELOPMENT

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CONTENTS

ABSTRACT

Among the economic activities in Brazil´s Midwest region, agriculture has an important role in the regional economy, with the aim of this study to evaluate the recent situation of regional agriculture in order to identify constraints and opportunities for development and discuss actions that may contribute to the expansion of regional production. A region that increased its participation in national agricultural gross domestic product (GDP), from 7.4% in 1970 to 19.5% in 2009, demonstrated in the recent past that it has favorable conditions for agricultural economically profitable exploitation. Several factors, however, are often mentioned as potential barriers to the development of agriculture in the region, including environmental issues, disability logistics, technological backwardness, lack of credit, lack of technical assistance, among others. For this competitiveness to continue and possibly even increase, many investments are needed, especially in improving the transportation infrastructure for transport of produce to consumer centers.

Keywords: agriculture; livestock; Midwest region; development.

SINOPSE

Dentre as atividades econômicas na região Centro-Oeste, a agropecuária tem papel de destaque na economia regional, sendo o objetivo desse estudo o de avaliar a situação recente da agricultura regional com o intuito de identificar limitações e oportunidades ao seu desenvolvimento e debater propostas de políticas públicas que possam contribuir para a ampliação da produção regional. Uma região que aumentou sua participação no produto interno bruto (PIB) agropecuário nacional, de 7,4% em 1970 para 19,5% em 2009, demonstrou no passado recente que possui condições favoráveis à exploração agropecuária economicamente rentável. Vários fatores, entretanto, são frequentemente apontados como potenciais entraves ao desenvolvimento da agropecuária na região, entre eles questões ambientais, deficiência logística, atraso tecnológico, falta de crédito, falta de assistência técnica, entre outros. Para que essa competitividade continue, e possivelmente até aumente, diversos investimentos são necessários, principalmente na melhoria da infraestrutura de transporte para escoamento da produção até os centros consumidores.

Palavras-chave: agricultura; pecuária; região Centro-Oeste; desenvolvimento.

1 INTRODUCTION

Brazil is currently one of the leading agricultural producers in the world. In recent decades, the Brazilian agricultural production grew significantly either through increase in productivity due to technological changes made to the production system, either through the incorporation of new areas of production to those areas already explored.

A considerable part of this dynamism took place in agricultural activities in the Midwest region. Until the mid 1970s, practically the only activities in the region were extensive livestock low yield farming and the cultivation of subsistence crops in small farms. From the late 1960s and, with increasing intensity, during the 1970s, the *cerrado*[1] biome, which covers almost the entire region, was gradually occupied by medium and large farming enterprises. Initially, the incorporation of large areas for cultivation of soybeans led this process of occupation of the Midwest, later came other crops such as corn and beans, and more recently the sugarcane began to expand throughout the region.

This process has been accompanied by changes occurring outside the production environment of the farms. Part of the success in the development of agricultural activities can be attributed, among other factors, to the intense and successful work of public research institutions to develop new technologies adapted to the soil and climatic conditions of the region. Institutions such as the Brazilian Agricultural Research Corporation (Embrapa) – *Empresa Brasileira de Pesquisa Agropecuária*, created in 1974, were effective in developing plant varieties adapted to the regional climate and soil, specifically to the drier regional climate and the low fertility soils than the existing in the South and Southeast regions.

Furthermore, primarily from the 1970s various subsidy mechanisms were created by the ruling military government to encourage the occupation of the region. This strategy was part of the objective of the various military governments to occupy the under populated Brazilian "hinterland", which consisted of the Midwest and North

1. The *cerrado* biome consists of a large region in central Brazil that has as main characteristics: 1 - prevailence of tropical climate with two distinct seasons: one dry season, between may and september, and one wet season between october and april; 2 - The predominant vegetation consists of deciduous species (falling leaves in the dry season) with deep roots adapted to the two distinct seasons. The vegetation is generally small, with gnarled branches and thick leaves; 3 - In general, the soils are poor and very acidic. Until 1970, the *cerrado* was ignored on its use for agriculture, but with scientific breaktrhoughs came new techniques that enabled its occupation for this purpose.

regions. Attests the success of the strategy to promote the development of agriculture and hence the occupation of the region, the fact that the share of its agricultural production with respect to the value of Brazil's total agricultural production jumped from 7% in 1970 to 19.5% in 2009 (Ipeadata, 2013).

This expansion of primary activities in the region did not occur, however, without generating adverse effects, for example, damage to the environment, especially in the *cerrado* and wetland biomes. The agriculture of the Midwest faces competition of production in other regions of Brazil and from abroad and to remain competitive needs to deal with internal challenges ranging from infrastructure related challenges such as transportation and storage infrastructural *deficit* through aspects related to productivity and environmental sustainability of the activities and, finally, related to income insurance to the producer.

Thus, the aim of this study is to assess the recent situation of agriculture in the Midwest region, based on data from the 2006 Agricultural Census. Based on this diagnosis, the study aims to identify constraints to agricultural development in the region and discuss measures that can contribute to the expansion of regional agricultural production with the generation of jobs and income for the population. This study follows the same structure of the work of Castro (2012a) on agriculture in Northeastern Brazil and Castro (2013) on agriculture in the Northern region.

To achieve the proposed objectives, the text is divided into three sections, besides this introduction. The second section makes a brief diagnosis of regional agriculture. The third section debates issues that constitute constraints to agricultural development in the region, for example, environmental issues, disability logistics, technological backwardness, lack of credit, lack of technical assistance, among others. The fourth section discusses some aspects which if well managed can overcome the bottlenecks that impede further regional agricultural development.

2 AGRICULTURE IN THE MIDWEST: PRESENT

The Midwest region is, together with the South and Southeast regions, the place in Brazil where agricultural activities are most profitable. Some regional agricultural products

stand out regarding the value of regional production and its diffusion throughout the Midwest´s territory. In this section some statistics on the regional agriculture and livestock production are presented and will base the discussion that will be held in sections 3 and 4 of this work.

Tables 1 and 2 present data on regional agriculture, such as the area of the agricultural farms, number of people employed (Table 1) and the value of production of major crops (Table 2). Whenever possible, the data presented will make a distinction between small (family) farming and commercial (agribusiness) farming in an attempt to demonstrate the share of small farming in the region. The definition of small farming used in this work is that of Brazilian Federal Government in accordance with Law 11,326[2] of 2006 (Presidency of the Republic, 2006).

Regarding the total land area of farms in the region, the data in Table 1 gives a hint on the large concentration of land. This is because of the disproportion between the share of small farms over the total number of farms in the region and the small farms´ area share over the total area of agricultural farms. While the number of small farms are responsible for about 69% of total farms, the area occupied by these farms is only about 9% of the total area. The same disproportion is not the case regarding the share of employed personnel in small farms over total employed personnel in all agricultural farms: 53%. The concentration of land in the Midwest is more evident than in the rest of the country. In the North, the area share of small farms over the total area of all agricultural farms is 19.5% in the Southeast it´s 19%, in the South it´s 23.9% and in the Northeast it´s 27.2 %.

2. Article 3 - For the purposes of this Act, the definition of family farmers and family rural entrepreneurs are those who practice activities in rural areas, serving both the following requirements:
I - does not hold in any capacity, area greater than four (4) fiscal modules;
II - use mostly hand labor of his own family in the economic activities of its establishment or undertaking;
III - have minimum percentage of household income arising from economic activities of their establishment or enterprise, as defined by the Executive Power; (Amended by Law N. 12,512, 2011)
IV - drive their establishment or undertaking with their own family.

TABLE 1
Number of agricultural farms, area and personnel employed in agriculture and livestock production, small farming and agribusiness, in the Midwest region in 2006

State	Number of agricultural farms		Total area of agricultural farms (ha)		Personnel employed in the farms		
	Total	Small farms	Total	Small farms	Small farms	Agribusiness	Total
Distrito Federal (DF)	3,955	1,824	251,320	10,867	6,481	15,843	22,324
Goiás (GO)	135,683	88,436	25,683,548	3,329,630	212,980	205,070	418,050
Mato Grosso (MT)	112,978	86,167	47,805,514	4,884,212	215,117	143,204	358,321
Mato Grosso do Sul (MS)	64,862	23,758	30,056,947	1,190,206	97,431	113,760	211,191
Midwest	317,478	217,531	103,797,328	9,414,915	532,009	477,877	1,009,886
Brazil	5,175,489	4,367,902	329,941,393	80,250,453	12,730,966	2,666,296	16,567,544

Source: IBGE – Censo Agropecuário 2006. Drafted by the author.

The data in Table 2 shows the total production values of small farming and agribusiness in the four states of the region. While small farming has great participation in terms of number of farms and employed personnel, with respect to their share in the production value it is still low, averaging around 13.5% on the states of the region. While this share is approximately 10.7% for the Federal District (Distrito Federal), it is 16.4% for the state of Goiás. With respect to products which account for most of the value of regional agricultural and livestock production, they include cows´ milk in first place and soybeans in second place.

TABLE 2
Total production value (PV – measured in Brazilian Reais – R$) of small farms and agribusiness and PV of selected small farming products in the Midwest - 2006

State	Production value				
	Total agricultural and livestock production in the Midwest (R$ 1,000)		Small farms selected products (R$)		
	Small farms	Agribusiness	Agricultural or livestock product with the biggest PV in the state	Agricultural or livestock product with the second biggest PV in the state	Agricultural or livestock product with the third biggest PV in the state
Distrito Federal	46,578	386,250	1,841,876 (Cows´milk)	1,360,135 (Manioc)	931,522 (Swine)
Goiás	1,028,726	5,213,525	356,621,130 (Cows´milk)	88,682,866 (Corn grain)	51,177,345 (Soybeans)
Mato Grosso	1,119,256	8,482,637	143,801,066 (Cows´milk)	109,071,251 (Soybeans)	59,658,100 (Corn grain)
Mato Grosso doSul	499,547	3,063,609	73,445,907 (Soybeans)	72,024,572 (Cow´s milk)	65,014,761 (Manioc)
Midwest	2,694,107	17,146,021			

Source: IBGE – Censo Agropecuário 2006. Drafted by the author.

In Table 3, the main agricultural products of the Midwest in terms of production value are presented.

TABLE 3
Production value (PV) and produced quantity of selected agricultural and livestock products in the Midwest (MW) in 2006

Product	Produced quantity in the Midwest		PV MW (x 1,000 R$)	PV Brazil (x 1,000 R$)	Main producting state in the MW	PV in the main producting state (x 1.000 R$)
	Quantity	Unit				
Swine (sold)	3,785,430	Number of animals	514,324	4,335,268	GO	213,435
Corn grain	9,366,235	tons	2,272,168	11,362,642	MT	1,023,597
Soybean grain	18,205,482	tons	6,974,247	17,141,485	MT	3,778,756
Chicken (sold)	338,892	Number of animals (x 10^3)	431,167	5,727,570	GO	159,095
Colored beans	149,397	tons	131,159	1,066,803	GO	85,991
Fish (aquaculture)	15,890,108	Kg	68,316	407,281	MT	34,742
Upland cotton	1,442,426	tons	2,200,886	3,233,189	MT	1,884,234
Rice	531,911	tons	206,562	4,030,145	MT	115,401
Sugar cane	41,821,200	tons	2,597,471	19,706,121	MT	1,318,689
Manioc	534,738	tons	151,929	3,686,632	MS	78,730
Cow´s milk	2,935,874	1,000 liters	1,205,373	8,817,536	GO	858,852
Cattle sold for breeding, rearing and fattening	4,382,507	Number of animals	2,134,496	5,282,311	MS	968,660
Cattle (male and female) with more than 24 months sold to slaughter	6,201,345	Number of animals	4,124,919	8,695,809	MS	1,797,590

Source: IBGE – Censo Agropecuário 2006. Drafted by the author.

The top five regional agricultural and livestock products in terms of production values are, as shown in Table 3, soy, beef, sugar cane, upland cotton and corn. Soybeans´ first place is not surprising if it´s considered that this crop has spread through the region since the onset of more intense colonization of the savannah (the *cerrado* biome) in the 1970s, nor the second of beef production, activity developed in the region since the eighteenth century.

Regarding the presence of sugar cane in third, that fact is surprising. A species historically cultivated in the states of São Paulo, Alagoas and Pernambuco, in the 2000s the sugar cane began to expand from the state of São Paulo, to neighboring states such as Paraná, Minas Gerais and in the case of the Midwest, Goiás. After Goiás this species was quickly introduced in large areas in the states of Mato Grosso and Mato Grosso do Sul and, in 2006, Mato Grosso already led the regional production of sugar cane. This

expansion coincided with the period of increasing interest for the Brazilian and global biofuel production, for which the sugar cane is a Brazilian species with technical and economic feasibility.

In Tables 4 and 5, the current land use in agricultural farms in the states of the Midwest is presented. It is perceived by this data the predominance of areas designed for temporary crops (soybeans, corn, beans, sugar cane ...) and pastures in all states of the region. Among the areas intended for grazing, it is important to note the predominance of areas occupied with planted pasture in good condition. This characteristic is different from other Brazilian regions where there is the predominance of grasslands, such as the Northeast (Castro, 2012a). Almost half of the area occupied with planted pastures in good condition in Brazil is located in the Midwest (Table 4).

TABLE 4
Land use in agricultural farms in the Midwest by type of use (ha)

State	Crops				Pastures		
	Permanent	Temporary	Harvesting fodder	Flower cultivation*	Grassland	Degraded planted	Planted in good condition
Distrito Federal	6,020	87,403	3,650	434	32,920	4,590	42,287
Goiás	247,691	2,971,230	386,116	1,704	3,133,884	951,125	11,624,863
Mato Grosso	397,353	5,734,408	189,094	2,620	4,367,238	1,605,374	15,812,123
Mato Grosso do Sul	60,745	1,943,374	176,201	3,513	6,197,149	777,722	13,968,943
Midwest	711,809	10,736,415	755,061	8,271	13,731,190	3,338,810	41,448,215
Brazil	11,612,227	44,019,726	4,114,557	100,109	57,316,457	9,842,925	91,594,484

Source: IBGE – Censo Agropecuário 2006.

* Área for flower cultivation (including hydroponics and plasticulture), seedlings nurseries and greenhouses.

With respect to the land use with permanent preservation areas (PPA) or legal reserve, in this case there is a difference in the states of the region in terms of the percentage of area for PPA or legal reserve over the total area of farming in each state. While this percentage for Brazil is 15.20%, in the Midwest region it rises to 21.63%, ranging from 15.69% in the case of Mato Grosso do Sul to 28.05% in Mato Grosso´s case. This higher percentage in the state of Mato Grosso was to be expected considering that the Northern section of this state is part of the Amazon forest biome where, by law, the percentage of area allocated to legal reserve is higher than in the *cerrado* biome.

TABLE 5
Land use in agricultural farms in the Midwest region by type of use (hectare - ha)

State	Woods			Agroforestry (ha)	Aquaculture (ha)	Degraded lands (ha)*
	Allocated to PPA or legal reserve (ha)/total area of the agricultural farms	Woods and/or natural forests (ha)	Planted forests with natural essences (ha)			
Distrito Federal	46,705/ 18,58	11,163	3,025	916	461	814
Goiás	4,384,474/ 17,07	857,682	80,030	318,362	76,795	44,602
Mato Grosso	13,412,226/ 28,05	4,848,744	68,395	357,006	89,778	67,705
Mato Grosso do Sul	4,716,351/ 15,69	1,101,429	101,822	164,868	72,638	33,402
Midwest	22,559,755/ 21,73	6,819,017	253,271	841,152	239,672	146,523
Brazil	50,163,102/ 15,20	35,621,638	4,497,324	8,197,564	1,319,492	789,238

Source: IBGE – Censo Agropecuário 2006.

* Eroded, desertified, saline.

Regarding livestock, in Table 6 information about the number of animals of each of the region´s main breeded species is presented. In this aspect, the region stands out in cattle breeding, accounting (in 2006) for about a third of the Brazilian herd of cattle.

TABLE 6
Effective livestock in the Midwest in 31/12/2006

	Livestock effective (number of animals)			
	Cattle	Sheep	Swine	Poultry (x1000)
Distrito Federal	79,889	16,046	109,364	11,397,941
Goiás	17,259,625	163,560	1,401,153	52,948,572
Mato Grosso	19,807,559	354,748	1,292,222	65,993,061
Mato Grosso do Sul	20,379,721	384,318	864,317	38,572,320
Midwest	57,526,794	918,672	3,667,056	168,911,894
Brazil	171,613,337	14,167,504	31,189,339	1,401,340,989

Source: IBGE – Censo Agropecuário 2006. Adapted by the author

3 AGRICULTURE IN THE MIDWEST: LIMITATIONS

In this section, we analyze the future prospects of agriculture in the Midwest focusing on those factors that constitute or may constitute limitations to the development of this activity. Several factors are often mentioned as potential barriers to such development, including environmental issues, disability logistics, technological backwardness, lack of credit, lack of technical assistance, among others.

With regard to environmental issues, in Tables 7 and 8 information on existing water resources in regional agricultural farms and their protection status are presented, while in Table 9 data on agricultural practices adopted in the farms are displayed. When comparing the total number of agricultural farms in each state with the number of farms with declaration of water resources, it shows that approximately 79%, 88%, 91%, 81% and 88% of farms, respectively, of the Distrito Federal, Goiás, Mato Grosso, Mato Grosso do Sul and the Midwest region as a whole declared ownership of water resources.

TABLE 7
Water resources in agricultural farms in the Midwest, by resource type

State	Farms with declaration of water resources possession	Resource type			
		Springs		Rivers or streams	
		Protected by woods	Without protection by woods	Protected by woods	Without protection by woods
Distrito Federal	3,123	1,280	127	2,001	69
Goiás	120,461	62,926	4,680	85,962	8,516
Mato Grosso	103,309	44,804	7,230	63,920	12,297
Mato Grosso do Sul	52,946	17,745	3,090	25,412	3,880
Midwest	279,839	126,755	15,127	177,295	24,762
Brazil	3,255,558	1,185,494	359,389	1,439,284	755,491

Source: IBGE – Censo Agropecuário 2006.

TABLE 8
Water resources in agricultural farms in the Midwest, by resource type (continuation of Table 7)

State	Resource type				
	Wells and/or cisterns			Natural lakes and/or dams	
	Common well	Artesians wells, semiartesian wells or tube wells	Cisterns	Protected by woods	Without protection by woods
Distrito Federal	887	715	2,855	387	308
Goiás	36,006	12,259	81,049	23,166	14,591
Mato Grosso	53,872	13,016	71,914	16,732	19,879
Mato Grosso do Sul	25,722	15,691	41,776	9,023	13,511
Midwest	116,487	41,681	197,594	49,308	48,289
Brazil	1,225,549	323,171	2,106,307	426,198	789,724

Source: IBGE – Censo Agropecuário 2006.

In a region where there is a period of prolonged drought (between the months of June and September) and because of it, in such time of year, irrigated agriculture constitutes an alternative for the farmer, this high percentage of farms with declaration

of ownership of water resources is important, although it isn´t a guarantee of water availability to all farmers who wish to invest in irrigated agriculture. With respect to irrigated agriculture, to allow for future sustainable development of this activity in the region[3], the Brazilian national water agency should undertake a review of water resources use grants.

Currently, the average annual consumption that actually exists in some basins is much less than the authorized consumption (via grants), and therefore, in order to improve the management of water resources in these basins, the review of grants is necessary to approximate the allowed consumption to the effective consumption. If such review is not made, there will be an impact on the development of economic activities in the territories of these basins, especially irrigated agriculture, due to the fact that new irrigated agriculture projects will possibly not be implemented due to the impossibility of obtaining grants for water use (Castro, 2012b).

With respect to the type of existing water resources in those farms and their preservation or not, it is clear that a significant amount of water is not yet protected by woods. An average of 11.93% of the water springs present in farms throughout the region are not protected, ranging from 7.43% in Goiás up to 17.41% in Mato Grosso do Sul. These numbers are better than the 30, 31% of unprotected springs in the case of Brazil as a whole, but still, given the proven benefits of resource protection and legal requirements in this regard, much can still be done in the Midwest to better protect these resources. In the case of rivers and streams, the percentage of those not protected is lower, ranging from 3.44% in the Distrito Federal to 19.23% in Mato Grosso do Sul.

3. "The possibilities for sustainable development of irrigated agriculture in Brazil take into account the existence of suitable soil, availability of water resources and meeting the requirements of environmental legislation and the Forest Code. Of the 30 million hectares able to incorporate the methods of irrigation, about 5 million are located in the Midwest (16.7%). " In: "Ministry of Agriculture, Livestock and Supply examines feasibility of Irrigated Agriculture ". Available at: http://www.agricultura.gov.br/vegetal/notícias/2013/03/mapa-analisa-viabilidade-do-pro-agropecuária-irrigada. Access in: May 12, 2013).

TABLE 9
Agricultural practices used in farms in the Midwest region by practice type

UF	Leveled planting	Use of terraces	Crop rotation	Use of crops for pasture recovery	Fallow soils	Crop or pasture burning	Slopes protection and/ or conservation	None of the mentioned agricultural practices
Distrito Federal	1,335	375	1,737	299	1,284	116	525	1,191
Goiás	25,703	4,757	7,700	12,658	3,971	946	11,998	84,468
Mato Grosso	13,230	2,524	6,359	7,349	2,884	4,527	10,010	77,148
Mato Grosso do Sul	12,954	4,807	5,996	4,195	2,119	470	4,838	40,154
Midwest	53,222	12,463	21,792	24,501	10,258	6,059	27,371	202,961
Brazil	1,513,860	194,104	641,071	270,987	331,554	702,025	296,915	2,176,757

Source: IBGE – Censo Agropecuário 2006.

On the main agricultural practices adopted in the region, the data from the 2006 Agricultural Census (IBGE, 2009) does not portray a very favorable situation, on average, for farms of the region referring to the use of agricultural conservationist practices. The majority of farms in the region do not use any of these conservationist practices listed by the 2006 Agricultural Census. A conservationist practice whose use in the region has increased over the last decades, however, is the no tillage cultivation system.

According to Duarte, Garcia and Matoso (n.d.), although the no-tillage system is used in Brazil since the early seventies, when of its introduction in the southern region of the country, its widespread adoption only took place in the nineties. In the *cerrado* biome, the use of the no tillage cultivation began later, around the eighties, and in the nineties and the beginning of the current century its use was quite intense. In 2006, according to the 2006 Agricultural Census (IBGE, 2009) the area planted using no-till in southern Brazil represented 48.35% of the Brazilian total, while the area with this system in the savannah (*cerrado* biome) represented 35.97%. Also according to the 2006 Census, the number of farms in the Midwest that use this system of cultivation was still small, 16,184. Despite that, the magnitude of the planting area using this system in the Midwest is due to the fact that predominantly farms with large areas for the production of corn and soybeans use this system.

In addition to problems related to the environmental impacts of agriculture, several other limitations on further development of these activities exist. According to Stulp and Plá (1992), cited by Ojima (2004), one of the aspects that most interfere

in the efficiency of various economic sectors of a given country is its transportation infrastructure. And regarding this rests a serious obstacle to the competitiveness of agriculture in Brazil as well as in the Midwest, which is the high cost of freight transport in the country.

In general countries with small territories prioritize highway transport, while countries with large areas, with the exception of Brazil, prioritize transport by rail and waterways, as these modes have greater efficiency and competitiveness in the transport of cargos through longer distances (Ojima, 2004). In addition, specifically for agriculture, the railroad and waterway are appointed by experts as the most suitable (Wanke, and Fleury, 2006). However, although the highway option is the most expensive (because of the long distances and precarious roads), the transport of agricultural products via highways is the most used in the country. Since the 1950s, Federal and state governments gave priority to the development of highways, justified by smaller investments and greater flexibility (door to door service).

Martins, Linos and Cyprino (2005) analyzed the case of Brazilian agribusiness and their demands on the transport system and found that given the characteristics of the Brazilian territory and of the spatially sprayed continental production as a consequence transport operations received a strategic connotation on the investment decisions of producers. Additionally, these authors point out that agricultural production has spread in the last three decades to the interior of the country, for the North and Midwest and huge areas of the Northeast, far away from the ports which give access to foreign markets. Also, they consider that agribusiness is characterized by forming extensive chains (large number of transaction agents between the raw material and the various market segments, with significant spatial dispersion), pointing to a substantial number of operations and low added value within each one. In this context, transport systems have been presented as a growing challenge to the competitiveness of Brazilian agribusiness.

The National Confederation of Transport (CNT) and the Center for Logistics (CEL) of COPPEAD - UFRJ conducted a diagnostic study of freight transportation in Brazil in which they identified its critical and unsustainable condition in the long term, if no actions are taken to reverse this situation. The dimensions used to measure the efficiency of freight transportation were: economic, transport supply, safety, energy and

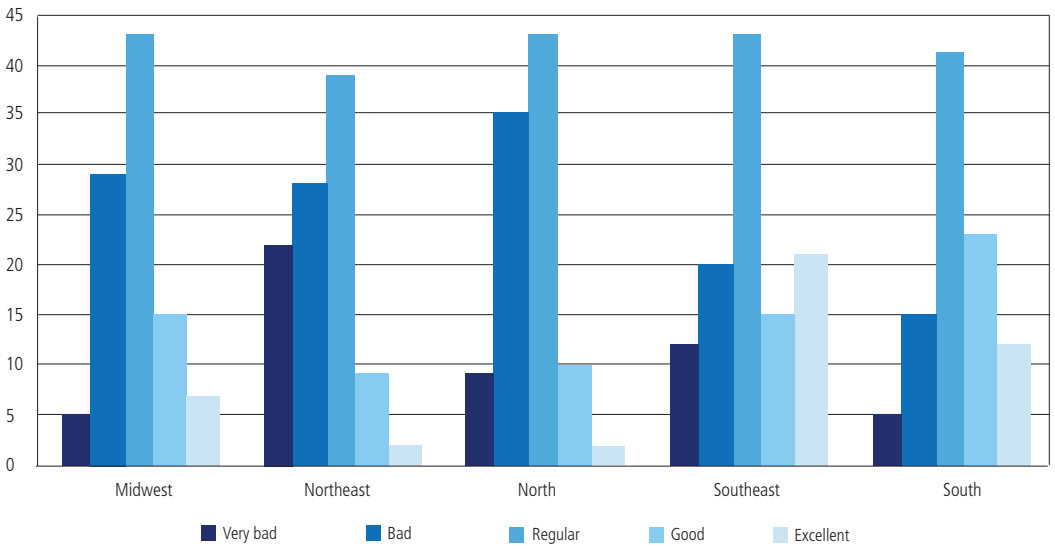
environment (CNT/UFRJ, 2008). With respect to the density of existing transportation network in Brazil measured in kilometers (km) of transport infrastructure available per square kilometer (km^2) area of the country, the study of CNT/UFRJ (2008) estimated that this index for Brazil was 26.4 km/km^2. For the same period analyzed, this study estimated the index at 38.3, 57.2, 48.3 and 447 respectively km/km^2 to China, Mexico, Canada and the United States. These numbers clearly indicate a deficiency of Brazilian transportation network.

Only 35% of waterways are effectively used for transportation, for lack of interventions in rivers and construction of onshore infrastructure (waterway terminals). One of the factors that influence rivers utilization rate in transportation is the delay in the resolution of issues related to environmental impacts of waterways. In order to invest in the construction of the necessary infrastructure to facilitate navigation in major Brazilian rivers, the Brazil in Action program was created in 1996 which provided an investment of R$ 317.4 million for infrastructure development of the Madeira, São Francisco, Tocantins-Araguaia and Tietê-Paraná river waterways.

According to the study of CNT / UFRJ (2008) the managers of these waterways informed, however, that only $ 69.2 million had been effectively used to attend the construction of the required infrastructure until 2002. Another example of little investment in the development of waterways is the case of the Araguaia-Tocantins waterway, which has not yet been put into practice. This waterway will have, if it is ever in operation, a large participation in the distribution of agricultural production of the Midwest region.

Regarding the condition of the roads, according to a study by the IBP/UFRJ (2007), most of Brazilian highways are in maintenance conditions that can be classified among regular, bad and very bad; better conditions are observed in the Southeast, and the worst, in the Northern region, as shown in Figure 1. Specifically with respect to highways in the Midwest, about only 20% were classified at the time of the study´s completion to be in good or excellent condition.

FIGURE 1
Condition of major Brazilian highways, by region



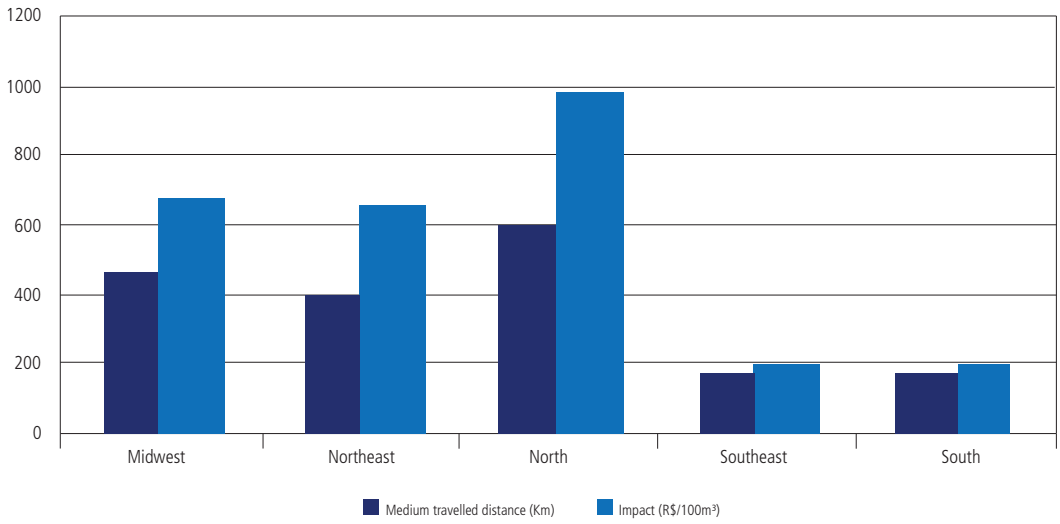
Source: IBP/UFRJ, 2007, adapted by the author.

The poor condition of roads has impacts on transportation costs. With relation to fixed costs the impact is approximately 18% of the total cost (average vehicle speed of 50 Km/h on a highway in good conditions reduced to 20km/h on one in bad conditions, allowing the conclusion of fewer trips per time period). Regarding variable costs (higher expenses with tire, lubricating oil, fuel and maintenance), the impact generated in the freight is about 8% of the total cost (IBP/UFRJ, 2007).

The same study (IBP/UPRJ, 2007) also calculated the impact of fixed and variable costs, considering distances to travel to different regions of the country. The results are shown in Figure 2. In this figure, we can observe that when the conditions are better for highway maintenance (which is the case in the Southeast and South regions), there is a closer relationship between costs and average distance. For the other regions, inadequate maintenance of roads has an impact on the higher freight costs, and without very direct correlation to the distance traveled. The largest impact is observed in the

North, the second largest impact occurs for the Midwest and Northeast; Southeast and South regions have the lowest impacts.

FIGURE 2
Impact highway condition in freight costs (in R$/100 m³)



Source: IBP/UFRJ, 2007, adapted by the author.

Other frequent limitations of agriculture and livestock production in the Midwest refer to technological backwardness. In Tables 10 to 14, many examples of technological limitations will be addressed. In Tables 10 and 11, information is presented regarding the use of fertilizer and limestone, respectively, in the region´s agricultural farms. It should be noted that the existing soils in the Midwest region are predominantly oxisoils with low natural fertility. This type of soil has as main features a good physical structure, resulting in overall good drainage, and low fertility. Besides this low natural fertility of most Midwest´s soils, they also present other unfavorable features for crop growth such as its high acidity.

This high acidity causes a reduced availability of nutrients for plants, which are available in greater quantity in the soil when the soil pH is situated around 6.5 (the pH is an unitless ratio ranging from 0 to 14 which is used to measure the acidity of a solution; the closer to zero the higher the acidity of the medium measured). In more acidic soils

(like most of the soils of the Midwest), with pH below 5.0 or 4.0, the essential nutrients for plants of agricultural interest are less available in the soil and other nutrients not usable by plants as the aluminum (which in higher concentration in the soil solution can be toxic to most plants of commercial interest) become more available.

TABLE 10
Farms with declaration of fertilizer use by type of fertilizer used in the Midwest – 2006

State	Farms with declaration of fertilizer use					
	Total*	Fertilizer type				
		Chemical nitrogen fertilizer	Non chemical nitrogen fertilizer	Manure and/or animal urine	Green fertilization	Uses, but didn´t have to in 2006
Distrito Federal	3,407	2,823	1,013	2,666	192	125
Goiás	43,331	36,959	8,399	7,233	582	10,376
Mato Grosso	12,175	8,655	3,330	2,885	734	3,504
Mato Grosso do Sul	13,003	9,940	2,304	2,255	320	3,625
Midwest	71,916	58,377	15,046	15,039	1,828	17,630
Brazil	1,695,246	1,325,838	244,733	627,930	139,191	143,322

Source: IBGE – Censo Agropecuário 2006.

* Including the ones that declared more than one product.

Generally, to obtain good agricultural yields cerrado soils, two very important practices are fertilization for improving soil fertility and lime application to reduce the acidity of the soil and make plant nutrients more available. Of the 317,478 agricultural farms in the region (Table 1), only 71,916 reported in 2006 to use fertilizer (Table 10), while 259,874 declared not to use lime. These numbers are troubling because they indicate that plant productivity, and even animal mass gain, obtained by farmers are lower than what would be obtained if these practices were adopted in farms where they are not adopted, which are the majority.

Even in the case of cattle breeding, as most of the existing cattle in the Midwest is solely fed with green pasture, lime application, a relatively cheap input, would enhance vegetative growth of pasture[4] and, because of this, would allow greater livestock yield either through greater mass gain per animal, either by increasing the animal stocking rate per unit of area, or even both.

4. In Brazil, the livestock production systems are characterized by the use of pasture as the main source of food and it´s reasonable to assume that more than 90% of food used for cattle fodder comes from pasture.

TABLE 11
Use of limestone and/or other soil pH corrective on farms in the Midwest region – 2006

State	Use of limestone and/or other soil pH corrective on farms in the Midwest region		
	Doesn´t use	Used in 2006	Uses but didn´t have to in 2006
Distrito Federal	940	1,800	1,215
Goiás	108,188	12,559	14,936
Mato Grosso	100,592	6,840	5,546
Mato Grosso do Sul	50,154	7,999	6,709
Midwest	259,874	29,198	28,406
Brazil	4,354,499	409,561	411,429

Source: IBGE – Censo Agropecuário 2006.

Another limitation of agriculture in the region is with respect to the deficiency of the storage infrastructure for agricultural products. In a region with large cattle herds, significant production of grain and cow milk (Table 3), the number of farms that have forage silos and tanks for cooling milk is small (Table 12). In the case of milk storage, of the 107,651 farms that declared to produce milk in 2006 (IBGE, 2009), only 10,259 (Table 14) had cooling tanks. This deficiency of infrastructure affects the marketing of the product, reducing the maximum period of storage without loss of quality. Regarding tanks and silos for grain storage, the number of farms that have this storage infrastructure (31,364) is not so small. To give a magnitude of this number, 42,889 farms produced corn grain and 13,085 produced soybean in 2006 (IBGE, 2009), two of the main crops produced in the region.

TABLE 12
Number of farms which possess forage silos, grain storage silos and tanks for cooling milk in the Midwest -2006

	Forage silos		Grain silos		Milk cooling tanks	
	Farms	Capacity (litres)	Farms	Capacity (litres)	Farms	Capacity (1,000 litres)
Distrito Federal	90	16,389	530	137,748	42	102
Goiás	8,681	1,319,408	21,248	1,592,856	8,128	11,805
Mato Grosso	747	114,499	6,693	3,365,960	883	1,475
Mato Grosso do Sul	800	247,801	2,893	727,602	1,206	1,743
Midwest	10,318	1,698,097	31,364	5,824,166	10,259	15,124
Brazil	153,972	17,247,432	672,941	26,544,993	145,595	115,297

Source: IBGE – Censo Agropecuário 2006.

Regarding the availability of tractors, indicative of the degree of investment in productive capital on the farms, of the 317,478 farms in the region, only about

20% (63,596 - Table 13) had at least one tractor in 2006. A considerable part of the approximately 254,000 regional farms that did not possess a traction machine, many of which probably still do not possess tractors, would benefit from increased operational capacity in agricultural operations like sowing, fertilizing, pesticide application, among others, attained through the availability of a motorized traction equipment, even low powered ones (below 100 hp).

TABLE 13
Number of farms with tractors and of available tractors in the Midwest´s farms – 2006

State	Number of farms which possess at least one tractor	Number of tractors	Power	
			Less than 100 hp	More than 100 hp
Distrito Federal	1,483	2,424	1,761	663
Goiás	24,597	44,832	25,013	19,819
Mato Grosso	18,442	42,329	19,157	23,172
Mato Grosso do Sul	19,074	37,900	19,817	18,083
Midwest	63,596	127,485	65,748	61,737
Brazil	530,337	820,673	570,647	250,026

Source: IBGE – Censo Agropecuário 2006.

To end this topic on the technological limitations of agriculture in the Midwest, we present some information about cattle production, an important agricultural segment in the region. According to Barcellos, Vilela and Lupinacci (2001), cattle ranching in Brazil´s Midwest was characterized since its early stages by the process of natural resource exploitation. According to these authors, with the adoption of cultivated pastures, especially those of the genus *Brachiaria*, livestock activity intensified. The degree of adaptation to low soil fertility and forage quality led to the formation of extensive areas of B. *Decumbens*, especially in the Midwest.

Barcellos, Vilela and Lupinacci (2001) explain that the pastures were established without fertilizer application to supply basic nutrients required by plants, which grew from the export of nutrients from the soil until its complete mineral depletion. These authors argue that this production model still exists in various locations in the Midwest until the present day. In good measure, this production model is responsible for much of the degraded pastures that exist in the Midwest: 3,338,810 hectares of degraded planted pastures according to IBGE (2009) (Table 4).

Contribute to this practice of not applying fertilizers to pastures, the technical ignorance of many producers on how economical and efficient (in terms of pasture enhanced yields) fertilization of pastures is and, often, the lack of technical assistance on this subject and other related to cattle ranching. Pastures that do not receive the recommended treatment in terms of fertilization and phytosssanitary care do not manifest all their productive potential and hence the whole system of animal production, be it beef cattle or milk production, has their final yield reduced. Low stocking rates, reduced weight gain per animal, long period of time between animal birth and slaughter are all consequences of careless pasture maintenance and animal feed (remembering what was mentioned earlier in footnote number 3).

Carvalho, Zen and Tavares (2009) compared beef cattle production systems on several farms in the major producing countries in the world and found major differences in stocking rate by country. While in German analyzed farms, the stocking rate ranged from 6.2 Animal Unit (AU)[5] to 7.0 AU and 4.8 AU in Canadian farms, in the farms analyzed in Brazil the stocking rate ranged from 0.55 in Tocantins (a state in the Northern region) to 0.7 AU (farm in southwestern Mato Grosso) and 0.9 AU (farm in northeast Mato Grosso do Sul) on farms in the Midwest.

Combined with this technological backwardness, in fact partly explaining it, is the issue of access to technical assistance for farmers. According to the 2006 Census data, the number of farms that received technical assistance is presented according to the type of received assistance. If it is considered that no property received technical guidance of different sources (which is likely not the case), the total number of farms that received technical assistance would be obtained by the sum of farms that reported receiving technical guidance from each of the sources presented in Table 14.

In this case, the total number of farms would be equal to 101,473 (Table 14). As the total number of farms in the region, as shown in Table 1, is equal to 317,478, making the assumption mentioned above means that at least about two-thirds of farms received no assistance. Moreover, as occurs in other Brazilian regions, with the exception of the South, the small number of farms that received technical assistance of

5. In this study, one animal unit (AU) is equivalent to 500 kg of live weight per hectare.

farmers associations in all states of the region is noteworthy and is an indicative of the small tradition in productive associations.

TABLE 14
Technical guidance received by producers, by guidance source, in the Midwest – 2006

State	Technical guidance received by producers, by guidance source						
	Government (Federal, State or municipal)	Self-guidance	Farmers associations	Integration productioncompanies	Private consultancies	Non governamental organizations	Other sources
Distrito Federal	2,564	481	46	126	138	6	118
Goiás	11,675	16,794	5,850	1,873	5,339	232	997
Mato Grosso	12,449	8,753	1,425	1,918	3,929	78	504
Mato Grosso do Sul	7,587	9,861	1,854	1,296	5,027	59	764
Northeast	127,362	52,894	7,404	5,248	8,715	3,607	5,733
North	53,592	13,430	4,401	1,167	2,121	340	577
Midwest	34,275	35,889	9,175	5,213	14,433	375	2,383
Southeast	119,002	87,093	53,039	13,241	19,200	1,012	11,679
South	157,369	60,935	151,502	128,989	40,726	1,459	9,962
Brazil	491,600	250,241	225,521	153,858	85,195	6,793	30,374

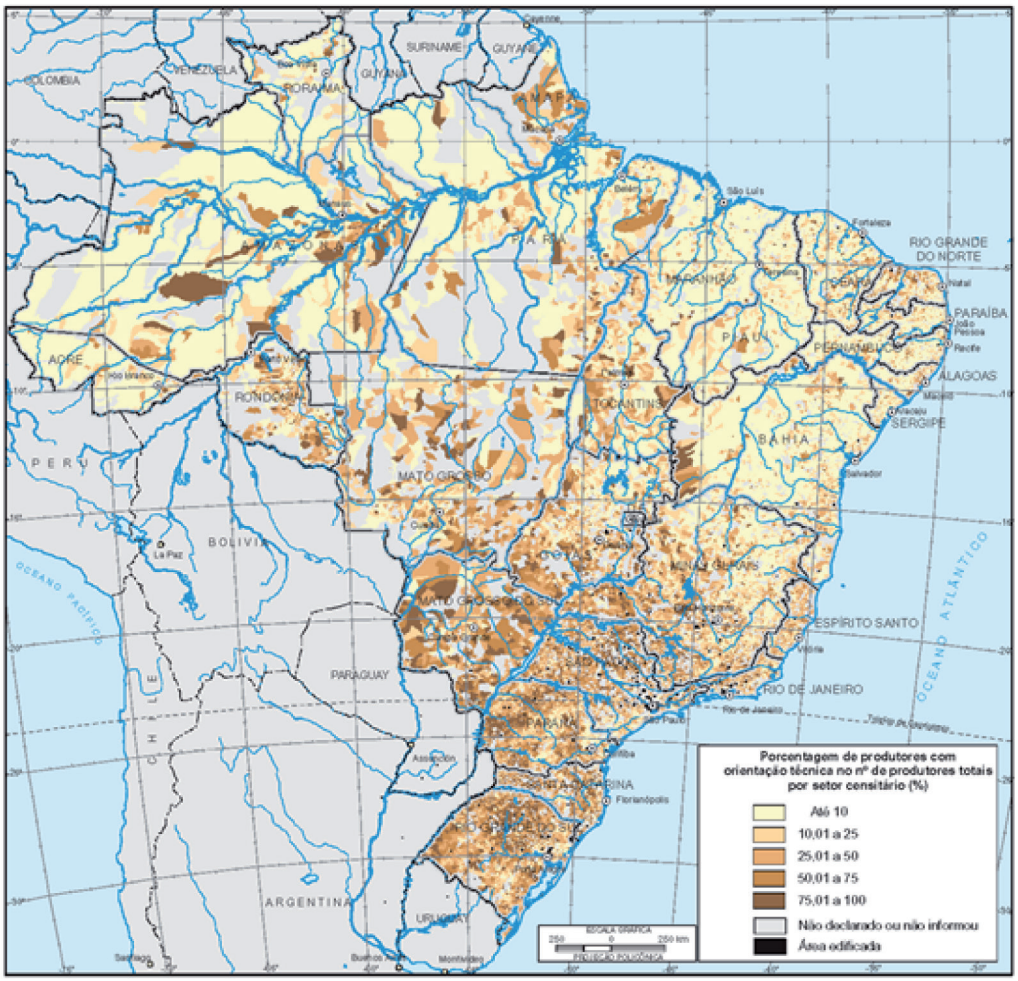
Source: IBGE – Censo Agropecuário 2006.

The information presented in Table 14 is supplemented by information contained in Figure 3. In this figure, it is observed that in the Midwest the number of farmers that receive technical assistance over the total number of farmers ratio is better, in percentage, in the state of Mato Grosso do Sul and in the southern state of Goiás. In the northern part of Goiás and Mato Grosso the technical assistance service´s coverage is comparable with the existing coverage in the North and Northeast (generally less than 10% of farmers). Besides the technical deficiency, the size of the official technical assistance institutions is insufficient to provide individualized guidance to farmers, which is the case of many farmers who depend on this type of guidance, notably most of the small family farmers.

This technical assistance deficiency is aggravated by the average low educational level of the farmers. According to IBGE (2009), in the Midwest approximately 70% of farmers have not completed elementary education (including illiterate or nearly so), around 13% have completed secondary or technical education and about 6% has completed higher education (Figure 4). Although the percentage of farmers with a college degree in the Midwest is the highest amongst all regions of Brazil, the average ill-educated

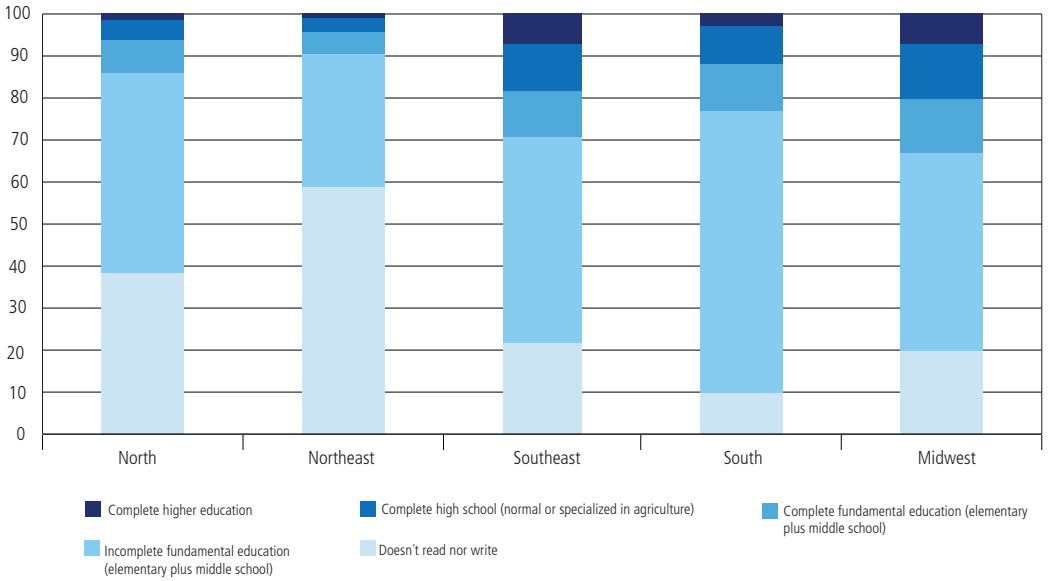
farmers negatively impact regional agricultural production because of its correlation to the non-adoption of modern technologies and to the no usage of sustainable agricultural practices, all resulting in losses in agricultural yields and farm incomes.

FIGURE 3
Percentage of farmers with technical guidance by census tract



Source: IBGE – Censo Agropecuário 2006.

FIGURE 4
Farmers´s distribution by level of education, by Major Region – 2006



Source: IBGE – Censo Agropecuário 2006.

An additional obstacle to agricultural production in the Midwest, as well as other Brazilian regions (Castro, 2012a; 2013) is the large number of farmers who cannot obtain credit in financial institutions for the development of productive activities (Table 15). Many farmers or companies have denied access to rural credit, often resulting in using their own resources as the only way to finance the crop. Among the main reasons for the denial to grant loans to farmers two stand out, bank bureaucracy and fear of farmers into debt.

TABLE 15
Farmers which have not received loans in the Midwest by the reason of the failure to obtain it – 2006

State	Number of farms	Lack of personal guarantee	Doesn´t know how to obtain a loan	Bureaucracy	Lack of payment of previous loans	Fear into debt	Other motiffs	Didn´t need a loan
Distrito Federal	3,329	244	42	465	93	586	338	1,561
Goiás	116,912	1,498	1,027	8,511	2,372	17,878	10,949	74,677
Mato Grosso	97,327	2,271	1,056	16,436	3,213	11,103	14,593	48,655
Mato Grosso do Sul	55,500	1,182	260	5,203	1,596	6,693	6,172	34,394
Midwest	273,068	5,195	2,385	30,615	7,274	36,260	32,052	159,287
Brazil	4,254,808	77,984	61,733	355,751	133,419	878,623	538,368	2,208,930

Source: IBGE – Censo Agropecuário 2006.

The success of agricultural colonization in the Midwest is due in large part to subsidized agricultural credit offered by the National Rural Credit System (SNCR) created in 1965. Between 1965 and 1986, this federal government funded institution provided significant and growing amount of credit to fund the productivity of several crops, especially the ones export orientated, with annual nominal interest rates lower, in most years of that period, than the annual inflation.

This period of cheap and abundant credit coincided with the beginning of the expansion of the occupation of areas in the Midwest region with agricultural activities, which took place in the late 1960s and especially during the 1970s and 1980s. Considerable part of the credit was intended to finance medium and large farmers and predominantly export crops such as soybeans. In addition, SNCR laid the foundation for the emergence of modern agriculture in the Midwest, one that prioritizes the provision of credit to farmers who adopt technologies of the green revolution, such as tractors and agricultural machinery as well as fertilizers and agrochemicals.

However, during the 1980s, due to the impact of the international economic crisis, which began in the 1970s, in the Brazilian economy, SNCR resources began to decrease and hence the credit to finance agriculture became more scarce. According to Bacha (2004), from 1987 the volume of rural credit decreased until the early 1990s, stabilizing around 1994 at values close to those prevailing in the early 1970s. During this period, the crisis of agricultural sector dominated the agenda for more than a decade and a new standard only began to emerge in the early 1990s, with recognition of the state´s inability to maintain the highly subsidized credit, honor prices promised by the policy of minimum price guarantee and ensure universal technical assistance service. Even today, funding is touted as one of the main obstacles to sustainable growth of the sector.

Silva (2012) analyzes the situation of rural credit in this context and mentions that among the alternatives that emerged was granting of credit by input suppliers, agro-industries and trading companies directly to producers. These companies have created funding mechanisms such as the production of "green soybeans".[6] According to this author, this new model, which goes on expanding, is prevalent in the financing of agriculture in the Midwest. Silva (2012) also concludes that Midwest producers

6. In the form of funding that was as "green soybeans," the good are private money needed for planting and harvesting, guaranteed payment of the crop.

depend on a relevant percentage of own resources to fund the production, among other reasons because the agricultural policy limits the amount of credit granted by R$ 650,000 (approximately US$ 275,000 using the average exchange rate of august 2013) per borrower. This ceiling is insufficient to meet the funding needs of the majority of grain farmers in the Midwest, which produce on a larger scale, and impose severe restrictions even in the smaller scale agriculture in the south of the country. This forces the producer to seek private funding or to use self-financing, whose share has increased.

4 AGRICULTURE IN THE MIDWEST: FUTURE CHALLENGES

In the previous section, some problems were exposed that limit the development of agriculture in the Midwest region, from infrastructural through environmental, technological, among others, which reduce the productive potential of agricultural and livestock activities in the region. This section deals in an exploratory mode with the evaluation of possibilities to mitigate these limitations and have the potential of impacting significantly the development of agricultural activities in Central Brazil.

The share of agricultural activities in the Midwest over the national agricultural GDP has grown significantly in recent decades (Table 16). This share which was 7.4% in 1970 jumped to 19.5% in 2009, more than a twice fold increase. In the same period, the Northeast and Southeast regions lost share in agricultural GDP. This considerable increase in the region´s share of agricultural GDP was a result of the intense and rapid process of agricultural colonization of the Midwest which began in the 1960s.

TABLE 16
Distribution of agricultural GDP among Brazilian regions
(%)

Region	Regional share of agricultural GDP				
	1970	1980	1990	2000	2009
Midwest	7.4	10.7	7.5	13.0	19.5
North	4.1	5.7	11.5	7.7	9.3
Northeast	20.9	19.5	18.8	16.4	18.1
South	26.6	29.5	26.6	30.4	25.9
Southeast	34.2	34.7	35.5	32.4	27.1

Source: IBGE *apud* Ipeadata.

To obtain a continued dynamism of agricultural activities in the region, with jobs and income generation, a set of initiatives that aim to restrict the constraints faced by the sector need to be taken. Among these initiatives, include the improvement of logistics infrastructure, the investment in innovation and technology diffusion, the expansion of access to rural credit, among others. These demands are not unique to Midwestern agriculture but also occurs, with minor variations, in Brazil´s other great regions.

With regard to rural credit, Silva (2012) demonstrated that the larger the area cultivated by a producer in the Midwest the greater his tendency to resort to inputs supplying companies (such as fertilizers, agrochemicals and seeds) to obtain credit to finance the crop. This fact occurs, according to this author, because of two main reasons: I) increased size of agricultural farms, which requires greater financing amount above the allowed credit limit controlled by the Ministry of Agriculture and Livestock Production (R$ 650,000); and II) greater farmers´ indebtedness in this region, especially in Mato Grosso state.

Because of the larger farm size, while in the South region 31% of the 2009/2010 soybeans crop funding costs came from the banking system, in the Midwest region this percentage was 17.3%. On the other hand, 23.7% of soybean funding in 2009/2010 in the Midwest was made by trading companies, agro-industries and grain exporters, while in the South region this percentage was only 7.2% (Silva, 2012). He concludes that a possible change which could facilitate the access of large farmers to finance the cost of annual harvest would be to tow the limit of operating credit contracted by a producer not to the CPF (a personal identification number used by Brazilian fiscal authority), but to the unit of cultivated area, based on the need for floating capital per hectare in the producing regions. Silva (2012) concludes on the need of agricultural credit policies definitions on a regional basis, taking in consideration the farming specificities of the farmers in each region.

If it is considered that even with the limitations imposed on farmers by the official credit system, the Midwest´s agricultural activities has developed to the point of significantly increasing its share of the national agricultural GDP in a range of just over thirty years (Table 16), the opportunity for agricultural activity in the Midwest with respect to agricultural credit consists in projecting what would have grown without the presence of such restraint. For all the limitations of regional agricultural development

presented in the previous section, the same considerations apply. Overcoming each production bottlenecks is in itself a development opportunity, with positive externalities one over the other. As an example, investment in agricultural conservation practices assists in promoting a more environmentally sustainable agriculture and, in some cases (such as the no-tillage cultivation system used in the region), more productive. As seen above, the situation of agricultural farms in the Midwest regarding the use of sustainable agricultural practices (Table 9) is not very auspicious.

One practice in particular that brings various benefits and that its adoption is growing in the Midwest is the no-tillage cultivation. The erosion caused by winds and rains contributes to large losses of soil layers, carrying organic matter and nutrients essential for plant growth. One way to minimize these effects is the no-tillage cultivation system, which concept is to plant without soil disturbance and with the maintenance of soil cover (using plant remains from the last harvested crop). In addition to this environmental benefit (reducing erosion), there are other benefits: lower consumption of fertilizers and pesticides (with reduction of production costs), lesser environmental impacts of agricultural production and the benefit of carbon sequestration due to the incorporation of organic matter in the soil, preserving soil moisture (reducing the risk of climate dry periods), among others.

One program created a few years ago by the Federal Government, which aims to encourage the adoption of conservationist practices, including no-tillage agriculture, is the Low Carbon Agriculture Program (ABC) of the Ministry of Agriculture, Livestock and Supply. This program (created in 2010) has several objectives, including: promoting the reduction of greenhouse gases in agriculture; recovery of degraded pastures; deployment and expansion of integrated crop-livestock-forest production systems; correction and fertilization of soils; the implementation of soil conservation practices; the restoration of the permanent preservation areas and legal reserves; the creation of incentives and funds for farmers to adopt sustainable agricultural techniques, among others.

With the ABC Plan the idea is to expand the sector's competitiveness, deepening the technological advances in the areas of sustainable production systems, plant-soil microbiology and degraded areas recovery. The ABC program in the 2010/2011 harvest had a R$ 2 billion grant and in the 2011/2012 harvest R$ 3.15 billion. According to data from the Bureau of Agricultural Policy of the Ministry of Agriculture, it is estimated

that only 15% of the 3.15 billion were used between July/2011 and February/2012, and most contracts were located in the South region of Brazil.

In 2012, however, of the R$ 310,334,000 spent in the ABC program (January-October 2012), the expenditure in the Midwest surpassed the South and were second only to the Southeast region. Expenditures were, respectively, R$ 89,519,000, R$ 76,853,000 and R$ 107,107,000 for each of these regions. Regarding budget execution it is still low for the ABC program as a whole. Between January and October 2012 only R$ 310,334,000 were spent in the Program from an available total of R$ 1.849.847.000[7] (by adding the resources from BNDES[8] and Banco do Brasil). Despite the low budget execution for the program and the concentration of the funds invested in the South region (until 2012), still this program has available budget to fund actions that promote the sustainability of agricultural activities in the Midwest with a view on greater environmental compliance of the region´s farms.

Another problem to affect regional agricultural development is the aforementioned precarious logistics infrastructure. According to Castro (2002), the relationship between the development of agriculture and transport are still poorly understood. However, the testimonies of farmers and producers in general located in areas poorly served by transport infrastructure does not leave much doubt about the importance of these services for the smooth functioning of economic activities in the Midwest. This author concludes with the need to expand the considered transportation network to include rail and waterway transportation, as well storage infrastructure and other logistics services.

In an attempt to direct public investment in order to boost economic growth, the Federal Government launched in January 2007, the Growth Acceleration Program (PAC), which aims to promote investment in infrastructure as to eliminate bottlenecks, boost private investment and reduce regional and social inequalities. The total investment planned by the Program is of R$ 503.9 billion. In March 2010, the second Growth Acceleration Program (PAC 2) was launched with additional resources

7. "Créditos de investimento com recursos do sistema BNDES – 2011/2012" and "Créditos de investimento com recursos do sistema BNDES – 2012/2013". Available at: http://www.agricultura.gov.br/vegetal/estatisticas. Access in: 14 June 2013.

8. BNDES is Brazil´s National Development Bank (Banco Nacional de Desenvolvimento Econômico e Social).

of R$ 1.59 trillion (as stated by the Brazilian Federal Government) in a number of sectors, such as transport, energy, culture, environment, health, housing and social area. The total planned investment by the two PACs in the segment of transportation infrastructure according to a survey conducted by the Federation of Industries of the State of São Paulo (2012) is presented in Table 17.

TABLE 17
Budget investment in regional transport PAC

Region	Total investment (1,000,000 R$)	% over Brazil's total
North	12,231	11.2
Northeast	39,644	36.5
Midwest	23,232	21.3
Southeast	22,131	20.3
South	11,629	10.7
Total	**108,869**	**100.0**

Source: FIESP (2012), adapted by the author.

According to FIESP (2012), these investments prioritized in PAC (Table 17) are concentrated in railways and highways geared to meet the largest demands for cargo transport: agribusiness and mining, with high concentration of resources allocated to Midwest, Northeast (the portion covered by *cerrado* biome) and Southeast regions (66% of total). Especially with regard to the situation of transport infrastructure, so vital to the competitiveness of farming in the Midwest, Pires (2000) warned that:

> the major bottleneck that can block the ongoing course of regional agricultural development which started in the 70s is the precariousness of regional infrastructure, particularly its transport system. Thus, it is expected that the development of infrastructure, improving the region's links with the national and international markets, will allow further growth of agriculture and agro-industry in the Midwest.

Despite this consideration of Pires (2000), the demands of farmers throughout the region and the findings of numerous researchers dedicated to this subject, little has been done in the past decade to improve the existing infrastructure. The Midwest, despite possessing natural comparative advantages for the development of agricultural activities compared to other Brazilian regions (including South and Southeast), such as its predominantly plain relief (well suited for agricultural mechanization), appropriate climate, soils with good physical structure, extent of agricultural land, among others,

see these advantages mitigated due to the cost of transportation between production areas and consumption centers to be considerably higher than that in the South and Southeast.

According to a study by the Federation of Agriculture and Livestock of the State of Mato Grosso (Famato), the transport of grain by waterway would reduce transport costs in around 70%[9] and by rail the reduction would be approximately 35%. Nevertheless, in 2011, 90% of soybean production in the state of Mato Grosso, the largest Brazilian producer, was transported by road. If it´s considered that in addition to the great distances to the ports of Santos and Paranaguá, more than 1,000 km, the condition of the roads is poor (see Figure 1), it is not difficult to empirically assess the potential gains in terms of reducing transportation costs through the investment in waterway and railway infrastructure.

This deficiency of the transport infrastructure in the Midwest region and its implications on the competitiveness of the agro-industrial complex of soy in the region has been the object of studies like that of Goldsmith & Hirsch (2006), in which these authors point out that the largest soybean producer in Brazil, the state of Mato Grosso, had in 2006 an installed capacity of crushing equivalent to only 38% of its grain production, while the remaining 62% of production needed to be transported long distances to states like Paraná and São Paulo for crushing, or worse, to be exported fresh (unprocessed soybeans) to countries like China, United States and Argentina, without the added value of the operation of crushing the basic raw material.

Besides the benefit generated by the improvement of freight on the dynamics of regional agriculture, the sector can also benefit considerably from productivity gains resulting from the processes of innovation and technological diffusion. The agricultural network of technological innovation in the region includes federal universities, federal science and technology institutions, such as Brazilian Agricultural Research Corporation (Embrapa) and others. The Midwest has a widespread network of agricultural research spread out through Distrito Federal and its other three states. The incorporation of the

9. Report *Centro-Oeste sofre para escoar produção de grãos* written by journalist Ana Conceição published in the newspaper O Estado de São Paulo on January 22, 2011. Available at: <http://www.estado.com.br/noticias/impresso, centro-oeste-sofre-para-escoar-producao-de-graos, 669 555,0.htm>. Access in: 12 June 2013.

cerrado biome by Brazilian agribusiness is one of the most obvious examples of success of the Brazilian agricultural research in the twentieth century.

The Midwest´s agricultural colonization coincided with the creation of Embrapa (created in 1974), which has several research centers in the region[10]. As an example of the research institutions contribution to regional agriculture, soy has an average yield of about 3,000 kg per hectare in the region, while in the South of Brazil the average yield is about 2,500 kg per hectare. Such examples constitute an indication of return that investment in research and development activities in the Midwest brought in terms of productivity growth and profitability of agricultural activities in the last decades. According to Almeida (n.d.), particularly the states of *Mato Grosso* and *Mato Grosso do Sul*, are producing scientific knowledge that is poorly absorbed by companies related to regional agribusiness in virtue of low interaction between the scientific and technological spheres and the fragility of the state and regional innovation system. According to this author, there is a concentration of innovative activities in *Goiás*: of 73 companies that invest in laboratorial research and development (R&D) in the region, 53 are located in this state. Of 38 to engage in continuous R&D in the region, 33 are located in *Goiás*.

Furthermore, the innovations generated by R&D institutions in order to attend society´s expected results demands its findings´ widespread use by the agricultural sector. In this sense, it is necessary the existence of an active and qualified technical assistance and rural extension service to perform this task. As seen previously (Table 16), however, the technical assistance and rural extension service in the region does not attend most farmers. Since the extinction of the Brazilian Technical Assistance and Rural Extension Corporation (Embrater) in the early 1990s, this activity was left to the states and henceforth the service´s quality is varied, but overall, has still a lot to improve.

The medium sized farms and certainly the major ones have easier access to technical assistance service offered by private companies. Thus, the challenge of research institutions, universities and social movements is to create strategies to put in practice participatory methodologies of rural technical assistance, which includes small family

10. Only in the Federal District are the national headquarters of the Company and five other research centers of Embrapa; in Goiás, there is one research center; in the state of Mato Grosso there is one as well and there are three Embrapa research centers in Mato Grosso do Sul state.

farmers from the conception to the implementation of technologies, transforming them in active technological diffusion agents, valuing their knowledge and respecting their wishes. This reality in the Midwest is not much different from other Brazilian regions except for the South region, where even small farmers have greater access to technical assistance services because, among other factors, of the widespread diffusion of the service provided by agricultural cooperatives.

Incidentally, about the productive associations, their promotion should be a desired goal of institutions linked to the development of regional agricultural sector. As mentioned in the previous section (in the analysis of the data of Table 14), the associative tradition of regional agriculture is small (at least compared to the existing tradition in the South region). Farmers could benefit from joining the agricultural cooperatives system in various aspects such as access to credit, access to technical assistance, purchase of inputs at a better price and selling produce in more favorable conditions. Especially small farmers can benefit from this system, which is clearly the case of *Paraná* state (in the South of Brazil), where the participation of farmers in cooperatives is very large. The Ministry of Agriculture has in its structure a Department of Livestock Development and Cooperatives (SDC) which has an important role regarding this matter. Along with the state department of agriculture and other public and private institutions, a comprehensive program could be created to structure an active network of agricultural cooperatives and hence demonstrate the benefits of membership in this system.

5 FINAL REMARKS

Despite all the growth of agriculture in the Midwest region in the past four decades, the agricultural sector still faces many bottlenecks that limit its future development. Various shortcomings negatively impact the sector, as was exposed throughout the work, from the issue of access to credit and technical assistance to regional logistics infrastructure deficiency.

A region that has increased its participation in national agricultural GDP, from 7.4% in 1970 to 19.5% in 2009, has demonstrated in the recent past that it has favorable conditions for economically profitable agricultural and livestock exploitation. Recent study by the Federation of the Industries of the State of São Paulo (2012) made

projections for the growth of agribusiness for the year 2022. Some of the projections are particularly promising for agribusiness in Brazil´s Midwest. Among these, that the region will be the largest producer of soybeans in Brazil, with 34% of the total, and upland cotton, with 55% of the total.

For this competitive edge to continue and possibly even increase (and confirm projections such as the stated above), various investments are needed, mainly on improving transport infrastructure from the production areas to consumer centers. However, although the Midwest region received considerable percentage of PAC resources destined for investment aimed at improving transportation infrastructure (as shown in Table 19), some problems persist. As an example, in the specific case of the Midwest, the transport of cargos via waterway is still disregarded as an effective alternative for large-scale transportation of cargo inside the region[11] and with the rest of Brazil.

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